CLAIMS:

The invention claimed is:

1. A method of fabricating a brachytherapy implant seed, comprising:

providing an inorganic amorphous silicate glass tube having an exterior surface extending axially along the tube;

coating at least a portion of the tube exterior surface with ceramic precursors;

after the coating, exposing the ceramic precursors to a temperature effective to form a continuous inorganic crystalline ceramic coating from the precursors over the tube exterior surface portion;

after the exposing, sorbing a therapeutic dose of radioactive material onto the ceramic coating;

providing at least a portion of the ceramic coated glass tube with therapeutic dose of radioactive material within an inorganic metallic cylinder; and

welding an inorganic metallic cap onto an end of the inorganic metallic cylinder having the portion of the ceramic coated glass tube with therapeutic dose of radioactive material therein.

2. The method of claim 1 wherein the ceramic precursors comprise an inorganic ion exchange material.

3. The method of claim 2 wherein the sorbing comprises contacting the ceramic coating with a solution comprising radioisotope ions having an affinity for the ion exchange material.

4. The method of claim 2 wherein the ion exchange material comprises at least one zeolite.

5. The method of claim 2 wherein the ion exchange material comprises silicotitanate.

6. The method of claim 1 wherein the glass comprises borosilicate material.

7. The method of claim 1 wherein the glass comprises phosphosilicate material.

8. The method of claim 1 wherein the inorganic crystalline ceramic comprises a metal silicate.

9. The method of claim 8 wherein the inorganic crystalline ceramic comprises an aluminosilicate.

10. The method of claim 1 wherein the ceramic precursors comprise sodium silicate and aluminum oxide, and the ceramic comprises sodium aluminosilicate.

11. The method of claim 1 wherein the therapeutic dose of radioactive material coats all of the tube exterior surface.

12. The method of claim 1 wherein the therapeutic dose of radioactive material coats less than all of the tube exterior surface.

13. The method of claim 12 wherein the therapeutic dose of radioactive material does not coat from 1.0mm to 4.0mm of a longitudinal central portion of the glass tube.

14. The method of claim 1 wherein the inorganic crystalline ceramic coating has a thickness of from 0.1mm to 0.4mm.

15. The method of claim 1 comprising providing a radiographic marker within the inorganic metallic cylinder prior to the welding.

16. The method of claim 1 wherein the coating is by aerosol spray.

17. The method of claim 1 wherein the coating is by liquid spray.

18. The method of claim 1 wherein the coating is by molding.

19. The method of claim 1 wherein the coating is by die casting.

20. The method of claim 1 wherein the coating comprises:

providing a vessel comprising a die passageway sized to slideably receive the tube therethrough to form a coating onto the tube exterior surface;

providing a mixture of the ceramic precursors within the vessel; and

moving the tube into the ceramic precursor mixture within the vessel and through the die passageway to out of the vessel effective to form a coating of the ceramic precursors onto the tube.

21. The method of claim 1 wherein the coating comprises:

providing a mold comprising a mold cavity sized to receive the tube and form a coating thereover;

inserting the mixture of ceramic precursors within the mold cavity;

inserting the tube within the mold cavity;

forming an adherent coating of the ceramic precursors onto the tube exterior surface with the mold cavity; and

after the forming, destructively melting the mold.

22. The method of claim 1 wherein the inorganic crystalline ceramic coating has a thickness which is the same as that of the inorganic amorphous silicate glass tube.

23. The method of claim 1 wherein the inorganic crystalline ceramic coating has a thickness which is greater than that of the inorganic amorphous silicate glass tube.

24. The method of claim 1 wherein the inorganic crystalline ceramic coating has a thickness which is less than that of the inorganic amorphous silicate glass tube.

25. A method of fabricating a brachytherapy implant seed, comprising:

providing an inorganic amorphous silicate glass tube having an exterior surface extending axially along the tube;

coating at least a portion of the tube exterior surface with ceramic precursors;

after the coating, exposing the ceramic precursors to a temperature effective to form a continuous inorganic crystalline ceramic coating from the precursors over the tube exterior surface portion, the ceramic coating having a thickness from 0.1mm to 0.4mm and comprising a silicate and a metal oxide;

after the exposing, sorbing a therapeutic dose of radioactive material onto the ceramic coating;

providing at least a portion of the ceramic coated glass tube with therapeutic dose of radioactive material within an inorganic metallic cylinder;

providing an inorganic metallic radiographic marker within the portion of the ceramic coated glass tube; and

welding an inorganic metallic cap onto an end of the inorganic metallic cylinder having the portion of the ceramic coated glass tube with therapeutic dose of radioactive material and the inorganic metallic radiographic marker therein.

26. The method of claim 25 wherein the inorganic metallic radiographic marker is provided within the ceramic coated glass tube prior to the sorbing.

27. The method of claim 25 wherein the inorganic metallic radiographic marker is provided within the ceramic coated glass tube after the sorbing.

28. The method of claim 27 wherein the inorganic metallic radiographic marker is provided within the ceramic coated glass tube after providing the ceramic coated glass tube within the inorganic metallic cap.

29. The method of claim 25 wherein ceramic precursors comprise an inorganic ion exchange material.

30. The method of claim 29 wherein the sorbing comprises contacting the ceramic coating with a solution comprising radioisotope ions having an affinity for the ion exchange material.

31. The method of claim 29 wherein the ion exchange material comprises at least one zeolite.

32. The method of claim 29 wherein the ion exchange material comprises silicotitanate.

33. The method of claim 25 wherein the continuous inorganic crystalline ceramic coating inherently has an affinity for the radioactive material without added ion exchange material.

34. The method of claim 33 wherein the sorbing comprises contacting the ceramic coating with a solution comprising radioisotope ions having an affinity for the continuous inorganic crystalline ceramic coating..

35. The method of claim 25 wherein the coating is by aerosol spray.

36. The method of claim 25 wherein the coating is by liquid spray.

37. The method of claim 25 wherein the coating is by die casting.

38. The method of claim 25 wherein the coating is by molding.

39. The method of claim 25 wherein the coating comprises:

providing a vessel comprising a die passageway sized to slideably receive the tube therethrough to form a coating onto the tube exterior surface;

providing a mixture of the ceramic precursors within the vessel; and

moving the tube into the ceramic precursor mixture within the vessel and through the die passageway to out of the vessel effective to form a coating of the ceramic precursors onto the tube.

40. The method of claim 25 wherein the coating comprises:

providing a mold comprising a mold cavity sized to receive the tube and form a coating thereover;

inserting the mixture of ceramic precursors within the mold cavity;

inserting the tube within the mold cavity;

forming an adherent coating of the ceramic precursors onto the tube exterior surface with the mold cavity; and

after the forming, destructively melting the mold.

41. The method of claim 25 wherein the inorganic crystalline ceramic coating has a thickness which is the same as that of the inorganic amorphous silicate glass tube.

42. The method of claim 25 wherein the inorganic crystalline ceramic coating has a thickness which is greater than that of the inorganic amorphous silicate glass tube.

43. The method of claim 25 wherein the inorganic crystalline ceramic coating has a thickness which is less than that of the inorganic amorphous silicate glass tube.

44. A brachytherapy implant seed comprising:

a sealed inorganic metallic cylinder having a radioactive core received therein, the radioactive core comprising:

an inorganic amorphous silicate glass tube having an exterior surface extending axially along the tube; and

an inorganic crystalline ceramic coating received on at least a portion of the inorganic amorphous glass tube exterior surface, said coating comprising a therapeutic dose of radioactive material; and

a radiographic marker received within the sealed inorganic metallic cylinder.

45. The brachytherapy implant seed of claim 44 wherein the glass comprises borosilicate.

46. The brachytherapy implant seed of claim 44 wherein the glass comprises phosphosilicate.

47. The brachytherapy implant seed of claim 44 wherein the inorganic crystalline ceramic comprises a metal silicate.

48. The brachytherapy implant seed of claim 47 wherein the inorganic crystalline ceramic comprises an aluminosilicate.

49. The brachytherapy implant seed of claim 44 wherein the therapeutic dose of radioactive material coats all of the tube exterior surface.

50. The brachytherapy implant seed of claim 44 wherein the therapeutic dose of radioactive material coats less than all of the tube exterior surface.

51. The method of claim 50 wherein the therapeutic dose of radioactive material does not coat from 1.0mm to 4.0mm of a longitudinal central portion of the tube.

52. The brachytherapy implant seed of claim 44 wherein the inorganic crystalline ceramic coating has a thickness of from 0.1mm to 0.4mm.

53. The brachytherapy implant seed of claim 44 wherein the inorganic crystalline ceramic coating has a thickness which is the same as that of the inorganic amorphous silicate glass tube.

54. The brachytherapy implant seed of claim 44 wherein the inorganic crystalline ceramic coating has a thickness which is greater than that of the inorganic amorphous silicate glass tube.

55. The brachytherapy implant seed of claim 44 wherein the inorganic crystalline ceramic coating has a thickness which is less than that of the inorganic amorphous silicate glass tube.

56. The brachytherapy implant seed of claim 44 wherein the inorganic amorphous silicate glass tube comprises longitudinally opposing ends which are sealed by inorganic amorphous silicate glass.

57. The brachytherapy implant seed of claim 44 wherein the radiographic marker is received within the inorganic amorphous silicate glass tube.

58. The brachytherapy implant seed of claim 44 comprising a pair of balls received within longitudinal ends of the sealed inorganic metallic cylinder.

59. The brachytherapy implant seed of claim 58 wherein the balls comprise radiographic marker material.

60. The brachytherapy implant seed of claim 58 wherein the balls comprise a therapeutic dose of radioactive material.

61. The brachytherapy implant seed of claim 58 wherein the balls comprise an inorganic crystalline ceramic coated with a therapeutic dose of radioactive material.

62. A method of fabricating a brachytherapy implant seed core, comprising:

providing a tube having an exterior surface extending axially along the tube;

providing a vessel comprising a die passageway sized to slideably receive the tube therethrough to form a coating onto the tube exterior surface;

providing a mixture of ceramic precursors within the vessel;

moving the tube into the ceramic precursor mixture within the vessel and through the die passageway to out of the vessel effective to form a coating of the ceramic precursors onto the tube exterior surface;

exposing the ceramic precursor coating to a temperature effective to form an inorganic crystalline ceramic coating over the tube exterior surface; and

after the exposing, sorbing a therapeutic dose of radioactive material onto the ceramic coating.

63. The method of claim 62 wherein the tube comprises an inorganic amorphous silicate glass material.

64. The method of claim 62 wherein the die passageway is sized to form the inorganic crystalline ceramic coating to have a thickness of from 0.1mm to 0.4mm.

65. The method of claim 62 wherein the ceramic precursors comprise an inorganic ion exchange material.

66. The method of claim 65 wherein the sorbing comprises contacting the ceramic coating with a solution comprising radioisotope ions having an affinity for the ion exchange material.

67. The method of claim 65 wherein the ion exchange material comprises at least one zeolite.

68. The method of claim 65 wherein the ion exchange material comprises silicotitanate.

69. The method of claim 62 wherein the inorganic crystalline ceramic comprises a metal silicate.

70. The method of claim 69 wherein the inorganic crystalline ceramic comprises an aluminosilicate.

71. The method of claim 62 wherein the ceramic precursors comprise sodium silicate and aluminum oxide, and the ceramic comprises sodium aluminosilicate.

72. The method of claim 62 wherein the inorganic crystalline ceramic coating has a thickness which is the same as that of the tube.

73. The method of claim 62 wherein the inorganic crystalline ceramic coating has a thickness which is greater than that of the tube.

74. The method of claim 62 wherein the inorganic crystalline ceramic coating has a thickness which is less than that of the tube.

75. A method of fabricating a brachytherapy implant seed core, comprising:

providing a tube having an exterior surface extending axially along the tube;

providing a mold comprising a mold cavity sized to receive the tube and form a coating thereover;

inserting a mixture of ceramic precursors within the mold cavity;

inserting the tube within the mold cavity;

forming an adherent coating of the ceramic precursors onto the tube exterior surface within the mold cavity;

after the forming, destructively melting the mold;

after the melting, exposing the ceramic precursor coating to a temperature effective to form an inorganic crystalline ceramic coating over the tube exterior surface; and

after the exposing, sorbing a therapeutic dose of radioactive material onto the ceramic coating.

76. The method of claim 75 wherein the tube comprises an inorganic amorphous silicate glass material.

77. The method of claim 75 wherein the mold comprises wax.

78. The method of claim 75 wherein the mold comprises plastic.

79. The method of claim 75 wherein the mold has a melting temperature less than or equal to 500°C.

80. The method of claim 75 wherein the mixture of ceramic precursors is inserted into the mold cavity before the tube is inserted into the mold cavity.

81. The method of claim 75 wherein the tube is inserted into the mold cavity before the mixture of ceramic precursors is inserted into the mold cavity.

82. The method of claim 75 wherein the tube comprises longitudinally opposing ends which are open, the tube having end surfaces and interior surfaces, said forming also forming the adherent coating onto the end surfaces and onto the interior surfaces.

83. The method of claim 75 wherein the tube has longitudinally opposing ends which are sealed as inserted into the mold cavity.

84. The method of claim 83 further comprising providing an inorganic metallic marker within the sealed tube.

85. A method of fabricating a brachytherapy implant seed, comprising:

providing an inorganic metallic cylinder;

welding an inorganic metallic cap onto an end of the inorganic metallic cylinder, the welding comprising firing a series of laser pulses towards the cap and cylinder while rotating the cap and cylinder effective to form a series of overlapping welds, adjacent welds overlapping one another by no more than 50% calculated as weld diameter overlap divided by weld diameter; and

providing a radioactive core within the inorganic metallic cylinder, the radioactive core comprising a therapeutic dose of radioactive material.

86. The method of claim 85 wherein the adjacent welds overlap one another by from 20% to 40% calculated as weld diameter overlap divided by weld diameter.

87. The method of claim 85 wherein the adjacent welds overlap one another by from 20% to 30% calculated as weld diameter overlap divided by weld diameter.

88. The method of claim 85 wherein the laser pulses are fired towards the cap and cylinder at a firing angle from perpendicular to an outer surface of the metallic cylinder.

89. The method of claim 88 wherein the firing angle is no greater than 30° from perpendicular to the outer surface of the metallic cylinder.

90. The method of claim 88 wherein the firing angle is from 15° to 30° from perpendicular to the outer surface of the metallic cylinder.

91. The method of claim 88 wherein the firing angle is from 18° to 22° from perpendicular to the outer surface of the metallic cylinder.

92. The method of claim 88 wherein the inorganic metallic cap has an outermost edge away from the inorganic metallic cylinder, the welding comprising aiming respective centers of the laser pulses at locations which are more proximate to said outermost edge than to an interface of the cap and cylinder.

93. The method of claim 92 wherein the welding comprises aiming respective centers of the laser pulses at said outermost edge.

94. The method of claim 88 wherein the laser pulses are fired towards the cap and cylinder at a firing angle from perpendicular to the outer surface of the metallic cylinder, the firing angle being in a direction towards a majority length of the metallic cylinder.

95. The method of claim 94 wherein the firing angle is no greater than 30° from perpendicular to the outer surface of the metallic cylinder.

96. The method of claim 94 wherein the firing angle is from 15° to 30° from perpendicular to the outer surface of the metallic cylinder.

97. The method of claim 94 wherein the firing angle is from 18° to 22° from perpendicular to the outer surface of the metallic cylinder.

98. The method of claim 88 wherein the laser pulses are fired towards the cap and cylinder at a firing angle from perpendicular to the outer surface of the metallic cylinder, the firing angle being in a direction away from a majority length of the metallic cylinder.

99. The method of claim 85 wherein,

the laser pulses are fired towards the cap and cylinder at a firing angle from perpendicular to an outer surface of the metallic cylinder, the firing angle being in a direction towards a majority length of the metallic cylinder; and

the inorganic metallic cap has an outermost edge away from the inorganic metallic cylinder, the welding comprising aiming respective centers of the laser pulses at locations which are more proximate to said outermost edge than to an interface of the cap and cylinder.

100. The method of claim 99 wherein the welding comprises aiming respective centers of the laser pulses at said outermost edge.

101. The method of claim 99 wherein the firing angle is no greater than 30° from perpendicular to the outer surface of the metallic cylinder.

102. The method of claim 99 wherein the firing angle is from 15° to 30° from perpendicular to the outer surface of the metallic cylinder.

103. The method of claim 99 wherein the firing angle is from 18° to 22° from perpendicular to the outer surface of the metallic cylinder.

104. The method of claim 85 wherein providing the radioactive core within the inorganic metallic cylinder occurs after the welding and is effective to form a sealed brachytherapy implant seed.

105. The method of claim 85 wherein providing the radioactive core within the inorganic metallic cylinder occurs before the welding.

106. The method of claim 85 comprising welding another inorganic metallic cap onto another end of the inorganic metallic cylinder.

107. The method of claim 106 wherein the welding the another inorganic metallic cap comprises firing a series of laser pulses towards the another cap and the cylinder while rotating the another cap and cylinder effective to form a series of other overlapping welds, adjacent other welds overlapping one another by no more than 50% calculated as other weld diameter overlap divided by other weld diameter.

108. The method of claim 85 wherein the inorganic metallic cylinder has a longitudinal axis, the firing angle extending to the longitudinal axis.

109. The method of claim 85 wherein the inorganic metallic cylinder has a longitudinal axis, the firing angle being laterally spaced from the longitudinal axis.

110. A method of fabricating a brachytherapy implant seed, comprising:

providing an inorganic metallic cylinder;

welding an inorganic metallic cap onto an end of the inorganic metallic cylinder, the welding comprising firing a series of laser pulses towards the cap and cylinder while rotating the cap and cylinder effective to form a series of overlapping welds, the laser pulses being fired towards the cap and cylinder at a firing angle from perpendicular to an outer surface of the metallic cylinder; and

providing a radioactive core within the inorganic metallic cylinder, the radioactive core comprising a therapeutic dose of radioactive material.

111. The method of claim 110 wherein the firing angle is no greater than 30° from perpendicular to the outer surface of the metallic cylinder.

112. The method of claim 110 wherein the firing angle is from 15° to 30° from perpendicular to the outer surface of the metallic cylinder.

113. The method of claim 110 wherein the firing angle is from 18° to 22° from perpendicular to the outer surface of the metallic cylinder.

114. The method of claim 110 wherein the laser pulses are fired towards the cap and cylinder at a firing angle from perpendicular to the outer surface of the metallic cylinder, the firing angle being in a direction towards a majority length of the metallic cylinder.

115. The method of claim 114 wherein the firing angle is no greater than 30° from perpendicular to the outer surface of the metallic cylinder.

116. The method of claim 114 wherein the firing angle is from 15° to 30° from perpendicular to the outer surface of the metallic cylinder.

117. The method of claim 114 wherein the firing angle is from 18° to 22° from perpendicular to the outer surface of the metallic cylinder.

118. The method of claim 110 wherein providing the radioactive core within the inorganic metallic cylinder occurs after the welding and is effective to form a sealed brachytherapy implant seed.

119. The method of claim 110 wherein providing the radioactive core within the inorganic metallic cylinder occurs before the welding.

120. The method of claim 110 comprising welding another inorganic metallic cap onto another end of the inorganic metallic cylinder.

121. The method of claim 110 wherein the welding the another inorganic metallic cap comprises firing a series of laser pulses towards the another cap and cylinder while rotating the another cap and cylinder effective to form a series of other overlapping welds, the laser pulses fired towards the another cap and the cylinder being at a firing angle from perpendicular to the outer surface of the metallic cylinder.

122. The method of claim 110 wherein the inorganic metallic cylinder has a longitudinal axis, the firing angle extending to the longitudinal axis.

123. The method of claim 110 wherein the inorganic metallic cylinder has a longitudinal axis, the firing angle being laterally spaced from the longitudinal axis.